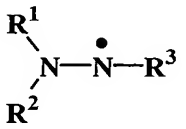
CLAIMS

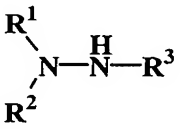
1. An oxidation catalyst for use in the oxidation of a substrate with a molecular oxygen, comprising at least one member selected from the group consisting of a hydrazyl radical represented by the formula (1) below and a hydrazine compound represented by the formula (2) below,

[Ka 27]



(1) , and

[Ka 28]



(2)

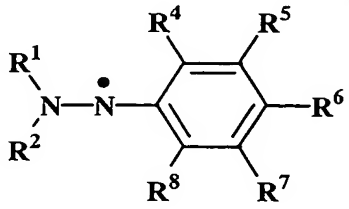
wherein each of R^1, R^2 and R^3 independently represents an aliphatic group, an aromatic group, a halogen atom, a hydroxyl group, a nitro group, a nitroso group, a cyano group, an amino group, an imino group, an azo group, a carbonyl group, a carboxyl group, an acyl group, an alkoxycarbonyl group, an aryloxycarbonyl group, a carbamoyl group, an alkoxyl group, an aryloxy group, a

haloalkyl group, a mercapto group, an alkylthio group, an arylthio group, a sulfo group, a sulfinyl group, a sulfonyl group or a heterocyclic group, or alternatively a group having two or more of these atom and groups; and

wherein two substituents selected from the group consisting of R^1, R^2 and R^3 are optionally bonded to each other, to thereby form a ring.

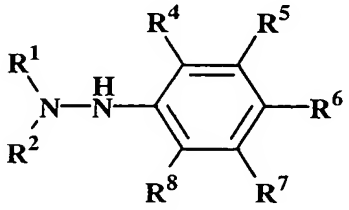
2. The oxidation catalyst according to claim 1, wherein said hydrazyl radical and said hydrazine compound are, respectively, represented by the following formulae (3) and (4):

[Ka 29]



(3) , and

[Ka 30]



(4)

wherein each of R^4, R^5, R^6, R^7 and R^8 independently represents a hydrogen atom, an aliphatic group, an aromatic group, a halogen atom, a hydroxyl group, a nitro group, a nitroso group, a cyano group, an amino group, an imino group, an azo group, a carbonyl group, a carboxyl group, an acyl group, an alkoxycarbonyl group, an aryloxycarbonyl group, a carbamoyl group, an alkoxyl group, an aryloxy group, a haloalkyl group, a mercapto group, an alkylthio group, an arylthio group, a sulfo group, a sulfinyl group, a sulfonyl group or a heterocyclic group, or alternatively a group having two or more of these atoms and groups;

each of R^1 and R^2 has the same definition as each of R^4 to R^8 except that any of R^1 and R^2 does not represent a hydrogen atom; and

wherein R^1 and R^2 are optionally bonded to each other, to thereby form a ring, and wherein with respect to one or two pairs of substituents selected from the group consisting of a pair of substituents R^4 and R^5, a pair of substituents R^5 and R^6, a pair of substituents R^6 and R^7 and a pair of substituents R^7 and R^8, the substituents

of the or each pair are optionally bonded to each other, to thereby form a ring or two rings.

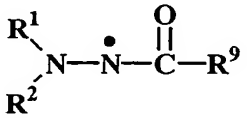
3. The oxidation catalyst according to claim 1 or 2, wherein said hydrazyl radical is selected from the group consisting of 2,2-diphenyl-1-picrylhydrazyl, 2,2-diphenyl-1-(2,6-dinitro-4-fluoromethylphenyl)hydrazyl, 2,2-diphenyl-1-(4-cyano-2,6-dinitrophenyl)hydrazyl, N,N-diphenyl-N'-(2,4,6-tricyanophenyl)hydrazyl, 1,3,5-tris(N,N-diphenylhydrazyl)-2,4,6-tricyanobenzol, 2,2-di-(4-tert-octylphenyl)picrylhydrazyl, carbazol-9-yl(2,4,6-trinitrophenyl) amidogen and N-phenyl-N-(4-trifluoromethylphenyl)-N'-(2,4,6-trinitrophenyl)-hydrazyl, and

said hydrazine compound is selected from the group consisting of 2,2-diphenyl-1-picrylhydrazine, 2,2-diphenyl-1-(2,6-dinitro-4-fluoromethylphenyl)hydrazine, 2,2-diphenyl-1-(4-cyano-2,6-dinitrophenyl)hydrazine, N,N-diphenyl-N'-(2,4,6-tricyanophenyl)hydrazine, 1,3,5-tris(N,N-diphenylhydrazino)-2,4,6-tricyanobenzol, 2,2-di-(4-tert-octylphenyl)picrylhydrazine, carbazol-9-yl(2,4,6-trinitrophenyl)amine and N-phenyl-N-(4-trifluoromethylphenyl)-N'-(2,4,6-trinitrophenyl)-hydrazine.

4. The oxidation catalyst according to any one of claims 1 to 3, wherein said hydrazyl radical is 2,2-diphenyl-1-picrylhydrazyl, and said hydrazine compound is 2,2-diphenyl-1-picrylhydrazine.

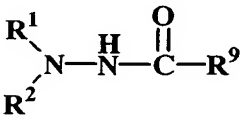
5. The oxidation catalyst according to claim 1, wherein said hydrazyl radical and said hydrazine compound are, respectively, represented by the following formulae (5) and (6):

[Ka 31]



(5) , and

[Ka 32]



(6)

wherein each of R^1, R^2 and R^9 independently represents an aliphatic group, an aromatic group, a halogen atom, a hydroxyl group, a nitro group, a nitroso group, a cyano group, an amino group, an imino group, an azo group, a carbonyl group, a carboxyl group, an acyl group, an alkoxycarbonyl group, an aryloxycarbonyl group, a carbamoyl

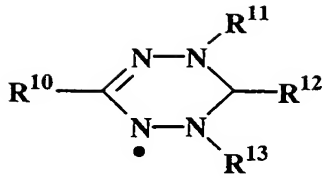
group, an alkoxyl group, an aryloxy group, a haloalkyl group, a mercapto group, an alkylthio group, an arylthio group, a sulfo group, a sulfinyl group, a sulfonyl group or a heterocyclic group, or alternatively a group having two or more of these atom and groups; and

wherein two substituents selected from the group consisting of R^1, R^2 and R^9 are optionally bonded to each other, to thereby form a ring.

6. The oxidation catalyst according to claim 1 or 5, wherein said hydrazyl radical is selected from the group consisting of 1-phenylpyrazolidone-(3)-radical and 3,4-dihydro-1,4-dioxo-3-phenyl-2-phthalazinyl, and said hydrazine compound is selected from the group consisting of 1-phenylpyrazolidine-3-one, 1-phenyl-1,2-dihydropyridazine-3,6-dione and 2-phenyl-2,3-dihydrophthalazine-1,4-dione.

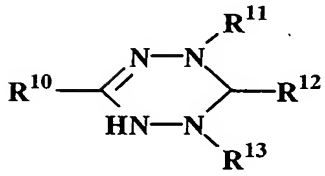
7. The oxidation catalyst according to claim 1, wherein said hydrazyl radical and said hydrazine compound are, respectively, represented by the following formulae (7) and (8):

[Ka 33]



(7) , and

[Ka 34]



(8)

wherein each of R^{10}, R^{11} and R^{12} independently represents a hydrogen atom, an oxygen atom, a sulfur atom, an aliphatic group, an aromatic group, a halogen atom, a hydroxyl group, a nitro group, a nitroso group, a cyano group, an amino group, an imino group, an azo group, a carbonyl group, a carboxyl group, an acyl group, an alkoxycarbonyl group, an aryloxycarbonyl group, a carbamoyl group, an alkoxyl group, an aryloxy group, a haloalkyl group, a mercapto group, an alkylthio group, an arylthio group, a sulfo group, a sulfinyl group, a sulfonyl group or a heterocyclic group, or alternatively a group having two or more of these atoms and groups;

R^{13} has the same definition as each of R^{10} to R^{12}

except that R^{13} does not represent a hydrogen atom; and

wherein two substituents selected from the group consisting of R^{11}, R^{12} and R^{13} are optionally bonded to each other, to thereby form a ring.

8. The oxidation catalyst according to claim 1 or 7, wherein said hydrazyl radical is selected from the group consisting of 2,4,6-triphenyl-3,4-dihydro-2H -[1,2,4,5]tetrazine-1-yl, 1,3,5,6-tetraphenylverdazyl, 1,3,5-triphenyl-6-oxoverdazyl and 1,3,5-triphenyl-6 -thioxoverdazyl, and

said hydrazine compound is selected from the group consisting of 2,4,6-triphenyl-1,2,3,4-tetrahydro -[1,2,3,4]tetrazine, 2,3,4,6-tetraphenyl-1,2,3,4 -tetrahydro-[1,2,4,5]tetrazine, 1,3,5-triphenyl-6 -oxotetrazine and 1,3,5-triphenyl-6-thioxotetrazine.

9. The oxidation catalyst according to any one of claims 1 to 8, which further comprises an oxidation promoter.

10. The oxidation catalyst according to claim 9, wherein said oxidation promoter is a transition metal compound.

11. The oxidation catalyst according to claim 10, wherein said transition metal is at least one member selected from the group consisting of the elements of the Groups 3 to 12 of the Periodic Table.

12. The oxidation catalyst according to claim 11, wherein said transition metal is at least one member selected from the group consisting of lanthanoids, Ti, Zr, Hf, V, Nb, Ta, Cr, Mo, W, Mn, Re, Fe, Ru, Os, Co, Rh, Ir, Ni, Pd, Pt, Cu, Ag, Au, Zn and Cd.

13. A method for producing a chemical compound, comprising contacting a substrate with a molecular oxygen in the presence of the oxidation catalyst of any one of claims 1 to 12, thereby performing an oxidation reaction to form a chemical compound.

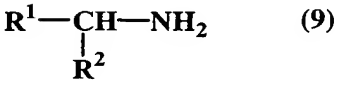
14. The method according to claim 13, wherein said substrate is selected from the group consisting of a hydrocarbon, an alcohol, a carbonyl compound, an ether, an amine, a sulfur compound and a heterocyclic compound.

15. The method according to claim 14, wherein said amine is a primary amine, and said chemical compound

produced is an oxime compound or a nitro compound.

16. The method according to claim 15, wherein said primary amine is represented by the following formula (9):

[Ka 35]



(9)

wherein each of R^1 and R^2 independently represents a hydrogen atom, an aliphatic group, an aromatic group or an aralkyl group, provided that R^1 and R^2 are not simultaneously hydrogen atoms; and

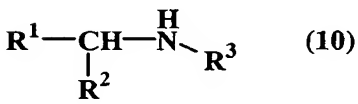
wherein R^1 and R^2 are optionally bonded to each other, to thereby form a ring.

17. The method according to claim 16, wherein said primary amine is cyclohexylamine, and said chemical compound produced is cyclohexanone oxime.

18. The method according to claim 14, wherein said amine is a secondary amine, and said chemical compound produced is a nitrone compound.

19. The method according to claim 18, wherein said secondary amine is represented by the following formula (10):

[Ka 36]



(10)

wherein each of R^1 and R^2 independently represents a hydrogen atom, an aliphatic group, an aromatic group or an aralkyl group, and R^3 has the same definition as each of R^1 and R^2 except that R^3 does not represent a hydrogen atom; and wherein two substituents selected from the group consisting of R^1, R^2 and R^3 are optionally bonded to each other, to thereby form a ring.

20. The method according to any one of claims 13 to 19, wherein said oxidation reaction is either performed in a reaction medium which is at least one member selected from the group consisting of water and an organic solvent, or performed using said substrate as a reaction medium.

21. The method according to claim 20, wherein said organic solvent is an aprotic solvent.

22. The method according to claim 21, wherein said aprotic solvent is at least one member selected from the group consisting of a nitrile, a nitro compound, an ester, an ether and an amide.

23. The method according to claim 22, wherein said nitrile is at least one member selected from the group consisting of acetonitrile and benzonitrile.

24. The method according to claim 22, wherein said amide is at least one member selected from the group consisting of dimethylformamide and dimethylacetamide.

25. The method according to any one of claims 13 to 24, wherein said at least one compound selected from the group consisting of the hydrazyl radical and the hydrazine compound is used in an amount of from 0.0001 to 1 mole per mole of said substrate.

26. The method according to any one of claims 13 to 25, wherein said oxidation catalyst further comprises an oxidation promoter, and said oxidation promoter is used in an amount of from 0.00005 to 0.8 mole per mole of said substrate.

27. The method according to any one of claims 13 to 26, wherein said oxidation reaction is performed under reaction conditions wherein the temperature is from 0 to 200 °C and the pressure is from atmospheric pressure to 20 MPa.